Fisheries and Oceans Pêches et Océans

Canadian Stock Assessment Proceedings Series 98/10

Évaluation des stocks canadien Séries des comptes rendus 98/10

Proceedings of the Transboundary Resources Assessment Committee

20 - 24 April 1998

Algonquin Hotel St. Andrew's, New Brunswick, Canada

R.N. O'Boyle, Chairman

Department of Fisheries & Oceans
Science Branch, Maritimes Region
Bedford Institute of Oceanography
P.O. Box 1006, Dartmouth
B2Y 4A2 Canada

June 1998

Canada

102-06210/

Proceedings of the Transboundary Resources Assessment Committee

20 - 24 April 1998

Algonquin Hotel
St. Andrew's, New Brunswick, Canada

R.N. O'Boyle, Chairman

Department of Fisheries & Oceans
Science Branch, Maritimes Region
Bedford Institute of Oceanography
P.O. Box 1006, Dartmouth
B2Y 4A2 Canada

June 1998

Table of Contents

Abstract / Résumé 4

Introduction 5

Report of the Transboundary Assessment Working Group (Rapporteur: E. Anderson) 7

Considerations on Alternative Model Formulations (Rapporteur: A. Parma) 8

Observations on Bias Correction of Parameter Estimates and Related Issues (Rapporteur: D. Clark) 9

The Need for Dialogue on Assessment Methodology (Rapporteur: R. O'Boyle) 10

Observations on the Transboundary Stock Assessment Process (Rapporteur: R. O'Boyle) 11

5Z+6 Cod (Rapporteur: R. Mayo) 12

5Zjm Cod (Rapporteur: J. Neilson) 16

5Z+6 Haddock (Rapporteur: S. Correia) 18

5Zjm Haddock (Rapporteur: L. VanEeckhaute) 23

5Zhjmn Yellowtail (Rapporteur: A. Sinclair) 26

References 29

Appendix I. List of Participants 30

Appendix II. Description of the TRAC Process 32

Appendix III. Report of the TAWG 35

Appendix IV. Meeting Remit 42

Appendix V. Meeting Schedule 44

Appendix VI. List of Working Papers 45

Appendix VII. List of Recommendations 46

Abstract

The first Transboundary Resources Assessment Committee (TRAC) meeting was held in St. Andrew's, N.B. during 20-24 April 1998 and provided a forum for the joint Canada/US peer review of the status of the Georges Bank cod, haddock and yellowtail resources. In the case of Canada, these discussions produced Stock Status Reports to be considered for the 1998 management plan. In the case of the USA, the meeting produced the stock status sections of the Advisory Report, which will be considered for developing harvest advice for 1999. Besides the stock assessments, a number of technical issues related to the assessments were raised, including alternate assessment approaches, bias correction, and the need for joint work on stock assessment methodology. As well, discussion on the TRAC was conducted to consider future improvements in the process. A number of recommendations were made to both improve the assessments and the process.

Résumé

La première réunion du Transboundary Resources Assessment Committee (TRAC) a eu lieu à St. Andrew's (N.-B.) du 20 au 24 avril 1998. Elle a servi de forum pour l'examen commun par les pairs canadiens et américains de l'état des stocks de morue, d'aiglefin et de limande à queue jaune du banc Georges. Dans le cas du Canada, elle a abouti à des Rapports sur l'état des stocks, qui serviront à l'établissement du plan de gestion de 1998. En ce qui concerne les États-Unis, la réunion a débouché sur les évaluations de l'état des stocks qui seront intégrées au Advisory Report, sur lequel seront fondés les avis concernant la récolte en 1999. Outre les évaluations de stocks, diverses questions techniques connexes ont été débattues, notamment d'autres méthodes d'évaluation, la correction des biais et la nécessité de travailler ensemble à la méthodologie d'évaluation. De plus, le TRAC a discuté d'améliorations futures au processus. Enfin, diverses recommandations visant à améliorer à la fois les évaluations et leur processus ont été formulées.

Introduction

The chair, R. O'Boyle, opened the meeting by greeting the participants (appendix I) and inviting them to introduce themselves. He then reviewed how the Transboundary Resources Assessment Committee (TRAC) had been established as a combined Canada/US peer review process for transboundary stock assessments. He noted that, whereas in the past, scientists from both countries had collaborated on scientific projects, the joint peer review of common assessments was only recent. In 1997, for instance, US scientists had presented their assessments of Georges Bank cod, haddock and yellowtail at the RAP meeting in Moncton during 21 - 25 April, at which time the Canadiam assessments were also reviewed. The US assessments were again reviewed at the 24th SARC during 19 - 23 May.

He then briefly described the TRAC process (appendix II), emphasing that it was evolving and would change with experience. The process consists of a Transboundary Assesment Working Group (TAWG), which prepares the assessments, and the TRAC which conducts the external peer review. The TAWG had met in Woods Hole in late March - early April to facilitate preparation of the working papers for this meeting. The report of the TAWG meeting is given in appendix III. The products of the TRAC are the peer-reviewed asessments, the Stock Status Reports for Canada and the Advisory Reports for the USA. The SARC later adds the management advice to the Advisory Report, as the TRAC only reviews the stock status.

The meeting remits were tabled (appendix IV) and briefly reviewed. It was pointed out that the review of the biological reference points would be carried out to the extent possible, as there had not been enough time for the TAWG to fully address these for the three US management units.

The schedule was tabled (appendix V). Besides the five assessment working papers, the report of the TAWG would be considered on the first morning. During the meeting, a number of technical issues related to the assessments were raised, including alternate assessment approaches, bias correction, and the need for joint work on stock assessment methodology. Time was allocated at the meeting to discuss these issues, the reports of which are provided herein. On the Friday morning, there would be a session on how well the new TRAC process was functioning. It was noted that travel arrangements had been made by many for the Friday afternoon, calling for an end to the meeting at 1200 rather than 1700 on that day as originally planned. Secretarial arrangements (photocopying, computing,etc) were then briefly covered.

R. O'Boyle outlined how the meeting would be conducted. For the Proceedings, a rapporteur was assigned for each stock. The senior author of each working paper would present the results of the analyses, during which questions of clarification only would be addressed. Following this, the external reviewer assigned to each stock would be asked to provide comment, after which the floor would be opened to general discussion. These reviewers had been sent background material and the 1998 working papers, as available, prior to the meeting.

The external reviewers by stock were:

5Z+6 Cod	A. Parma
5Zjm Cod	J. Witzig
5Z+6 Haddock	R. Cook
5Zjm Haddock	V. Haist
5Zhjmn Yellowtail	R. Mohn

A list of the working papers presented at the meeting is given in appendix VI and a list of the recommendations produced at the meeting is given in appendix VII.

Report of the Transboundary Assessment Working Group
(Rapporteur: E. Anderson)

The chairman (Loretta O'Brien, USA) of the Transboundary Assessment Working Group (TAWG) reviewed a number of issues germaine to the assessments of all three species which had been raised at the TAWG meeting (Appendix III). These included:

1) Sampling of 1997 USA commercial landings: poor spatial coverage of eastern Georges Bank; inconsistent seasonal coverage among species.

2) Discarding: regulatory discards of haddock by USA fishermen because of trip limits; no sampling of groundfish discards from the Canadian scallop fishery.

3) Fishery-based mean weights vs survey mean weights: consistency required in use of mean weights at age for calculating biomass; survey mean weights at age more appropriate if sampling is representative of entire length range of population.

4) USA spring survey gear catchabilities: Yankee 41 (1973-1981) and Yankee 36 (all other years) trawls in USA spring series treated as separate series for ADAPT tuning.

5) Ageing agreement: USA/Canada agreement in ageing declining with directionality; ageing workshop needed.

- **The TAWG recommended a USA/Canada Ageing Workshop, with time, place, and agenda to be arranged by the respective scientists in charge of age reading in Woods Hole and St. Andrews**

  The TRAC endorsed this recommendation.

6) Bias adjustment in bootstrap calculations: differences between bootstrap means and point estimates; controversy over whether or not to bias correct; clearer understanding of underlying causes of bias required.

7) Plus group and age range considerations for yield per recruit analyses: appropriate weighted mean weight needed for plus group.

The controversality of the bias correction issue associated with bootstrap calculations was explained and discussed, with emphasis placed on the need for a clearer understanding of the underlying causes of bias. It was pointed out that the magnitude of the bias should dictate how important it is to correct for it. There was considerable discussion on this issue, although it was realised that this TRAC meeting was an inappropriate forum to resolve these highly technical issues. Therefore, the group suggested that a Methods Working Group be established to meet intersessionally to address these and other methods-related problems. R. O'Boyle and E.

Anderson agreed to compile a draft terms of reference for consideration later in the meeting. The results of this discussion are presented below.

Considerations on Alternative Model Formulations (Rapporteur: A. Parma)

The assessments of the five stocks reviewed were conducted using backward catch-at-age analysis (VPA) tuned to survey indices of abundance by age. The basic model structure is fairly uniform across all the assessments, and is based on the assumptions that catch-at-age is observed without error, natural mortality is known, and survey indices are lognormally-distributed with constant error. Nonparametric bootstrap techniques are used to quantify uncertainty and compute probabilities of meeting various management goals. Estimated uncertainties are conditioned on the structure of the model being correct and so they tend to understate the true uncertainty of the assessment results.

The TRAC discussed some alternative approaches that will be worth exploring for future assessments:

(1) The use of different assumptions about the error of the survey indices, such as multinomial or weighted log-normal distributions. Limited sensitivity analyses conducted on the haddock assessment showed that abundance estimates dropped substantially when the lognormal distribution assumed in the base assessment was replaced by a multinomial distribution. The TRAC could not decide which of the two approaches would be more appropriate based on the information at hand, which illustrates that the actual uncertainty about stock status can be substantially larger than indicated by the assessments.

(2) Estimation of trends in relative abundance and total mortality from survey data alone. While absolute abundance cannot be estimated without catch information, the TRAC found it useful to contrast trends in abundance and fishing mortality indicated by the surveys with those estimated using VPA. For example, a separable model fitted to survey indices of age-specific abundance for cod indicated similar trends in mortality and year- class-strength as the assessment. Other methods explored based on linear models could not corroborate the strong reduction in fishing mortality estimated by the assessments.

(3) Allowing for errors in the catch at age observations. The assumption that catch at age is known can result in unrealistically high variability in the age specific exploitation pattern. It would be of interest to evaluate the effect of relaxing this assumption on both the point estimates and their estimated uncertainty.

(4) Extending the range of years used in the assessment to make use of the complete series of survey observations dating back to 1963. While this may not be necessary for estimating current stock status, the evaluation of management options and reference points cannot be accomplished by only looking at a restricted period during which biomasses have been very low compared to historical averages. Longer-term trends in productivity need to be

considered for stock-recruitment analysis, as exemplified by haddock and cod. The extension of the analysis to cover periods for which the age composition of the catch is unknown may not be straightforward using backward catch-at-age analysis. The integration of various pieces of information in a unified assessment could be more easily accomplished using forward catch-at-age methods, which do not depend on knowledge of catch-at-age to reconstruct population abundance.

These issues would be the topic of an intersessional meeting as discussed above.

Observations on Bias Correction of Parameter Estimates and Related Issues (Rapporteur: D. Clark)

Discussion focused on the rationale for the correction, how it is applied, and when it is most appropriate to apply it. The discrepancy between the point estimate of exploitation rate for a given quota and the quota corresponding to 50% risk prompted this discussion. The point estimate should correspond to the median on this distribution plot.

In general, it is inappropriate to do projections from bias corrected data, since the projections will introduce further bias. Bias correction, if it is to be done, should be conducted on the variable in question. If the system is close to linear, then the bias will be small. This is generally the case with VPA results; thus, using a bias corrected VPA for deterministic projections gives values similar to the mean of the bias adjusted probability distribution. If the variable is constrained to be positive, and the bias is positive, bias correction will result in a steeper probability distribution. It does not necessarily produce a symmetrical probability, and does not simply shift the line to the left.

The TRAC agreed to the following:

- We wish to characterize the uncertainty of fisheries management quantities (projections or current year values).
- It is preferable to derive empirical bootstrap distributions rather than assuming a normal distribution.
- Empirical bootstrap distributions can be derived either by the "percentile" or the "bias corrected percentile" methods. In the statistical literature, the "bias corrected percentile" method is considered preferable, but the differences will depend on the degree of bias.
- Point estimates of the management quantities, when adjusted for mean bias, will correspond closely, but not exactly, to the 50^{th} bias corrected percentile.
- There may be a noticeable discrepancy between the point estimates, which are not adjusted for bias and the 50^{th} percentile when bias is large.

- The effects of model misspecification on estimates of bias and bias corrected percentiles have not been explored.

As with the alternate assessment approaches, these issues could be further explored at an intersessional meeting.

The Need for Dialogue on Assessment Methodology (Rapporteur: R. O'Boyle)

Stock assessment methodologies in eastern and western North America have developed independently for a considerable time. Methods developed in the east have benefited from a strong European influence, particularly through ICES and have evolved from the 'backward' calculating Virtual Population Analysis, which builds population profiles based heavily on the catch information. Methods developed in the west are characterized as 'forward' calculating with emphasis on defining models that fit a wide assortment of input data situations. This meeting had participation from scientists with expertise with both model approaches and underlined the unique position that the east coast of North America had in forming a bridge between the eastern and western approaches.

A need was identified at the meeting to develop a forum for ongoing dialogue among assessment scientists which would foster development of the field. This was seen as particularly important given both recent advances in the field as well as the relatively small pool of expertise in this discipline. This forum would

- Provide a means for the exchange of ideas, concepts and methods relating to stock assessment methods.

- Provide the TRAC with a process to review assessment approaches in an intersessional meeting.

- Provide a means to disseminate knowledge, expertise, and procedures on stock assessment methods throughout the TRAC area.

This forum would be separate from the assessment meeting as the latter rightly focuses on the determination of stock status rather than the methodology. Not only is there not enough time at the assessment meeting to address methodological issues but also the expertise required for discussions on methodology would be different.

The TRAC discussed a number of options for this forum, including the use of the ICES Working Group on Methods of Fish Stock Assessment, use of existing bodies in SARC and RAP (the SSSC), establishment of a group in NAFO, and creation of a new forum under the TRAC. In the case of the ICES Working Group, it was felt that unless the meetings were held in North

America, the intent for east/west dialogue on assessment methods would not be met. Also, the appropriate SARC and RAP groups have not been active in recent years. Thus the group agreed that it would be useful to establish a separate process under the TRAC. However, rather than set up a formal working group, it was considered more appropriate at this stage to hold a workshop, sponsored by the TRAC with the flexibility for co-sponsorship by other national or international bodies, and see where this leads us.

- **It was recommended to hold an assessment methods workshop on the east coast in January 1999. The issues to address would include an examination of alternative models as well the communication and interpretation of risk.**

R.O'Boyle and E. Anderson agreed to take this recommendation back to their respective steering committees to seek approval and dependent upon this to initiate planning for the workshop.

Observations on the Transboundary Stock Assessment Process (Rapporteur: R. O'Boyle)

As discussed in the introduction, the Joint Canada/USA Stock Assessment Process for Transboundary Resources consists of a working group (TAWG) which prepares the assessments, and a peer-review body (TRAC) composed of individuals from outside of the working group which reviews the results of the working group. The purpose of the TRAC is to provide quality control to the activities and products of the TAWG.

A main concern raised with this process, on the basis of the first set of TAWG and TRAC meetings, was the insufficient time at the 1-week peer-review meeting to investigate the full range of analytical possibilities. The sentiment was expressed that if the intent is to inject new ideas and methods into the process, it would be more efficient to involve external experts at the working group level rather than at the TRAC level. However, it was countered that even the TAWG meeting, which is of 1-week duration or less, does not allow sufficient time for the discussion and consideration of new methods. As noted elsewhere in the Proceedings, it was recommended that an intersessional methods workshop be held to specifically address analytical concerns that had been raised at both the TAWG and TRAC meetings (e.g., quantifying variability and error sources in all aspects of the assessment and forecasting processes, consideration of alternative assessment methodology).

Some of the external participants felt that involvement of international experts was not necessary on an annual basis, particularly if the same stocks were reviewed each year, but rather from time to time as a quality check. However, it was countered that the involvement of external experts at the TRAC level was important each year to ensure that the working group did not become 'internally driven'. External referencing was viewed as a key function of the peer-review process.

While there were a number of potential improvements discussed, the group generally felt that the present TRAC meeting had been effective in achieving its mandate. The level of expertise

represented in the external participants was viewed as being of a very high standard. R. O'Boyle and E. Anderson agreed to take the suggestions for improvement under advisement for future TRAC meetings.

The second major issue raised on the process was the apparent inefficiency from the need to consider two assessments for each of the cod and haddock resources when the area of geographic overlap is extensive. The reasons for the existing management unit definitions were related to the effective management of the resources and still apply. However, it was recognized that there was merit in undertaking analyses of the distribution of the Georges Bank cod and haddock resources and investigating alternative assessment unit definitions. R.O'Boyle and E. Anderson agreed to undertake dialogue in their respective organizations on this issue.

- **It was recommended that Canada and the USA undertake analyses on the distribution of Georges Bank cod and haddock, and investigate alternative assessment unit definitions.**

5Z+6 Cod
(Rapporteur: R. Mayo)

The assessment was presented by Loretta O'Brien Comments below reflect the discussion which followed presentation of the results.

The Fishery

It was noted that the **age composition** of the USA landings differed from that of the Canadian landings in 1997. It was queried if this difference was a result of different age/length relationships derived from the Canadian ages from unit areas 5Zj and m, and USA ages based in part on samples taken from areas in the western part of Georges Bank? The reply was that the proportion of the USA catch taken by longline gear has increased somewhat in recent years and it was noted that this gear type appears to take smaller fish due in part to the location of the fishery in the area to the west of the South Channel.

A question was raised on how differences in **gear selectivity** were taken into account in the application of sampling data to estimate catch at age. It was then pointed out that the USA sampling protocol incorporates stratification by market category. Also, the length composition of the catch is similar for all gear types within each market category. Therefore, all samples are pooled over gear type within market category and applied to the landings by market category.

It was suggested that the **spatial distribution** of the catch by gear type, and possible differences in the age-length relationships within the selection age range of the various gear types should be investigated to better explain the overall age composition of the catch.

- **It was recommended that further analyses of the spatial distribution of the fishery by gear type be conducted to evaluate the influence of gear on the age composition.**

It was noted that the **recreational** cod fishery accounts for up to 10% of the total reported 'landings' from this stock. The effect of not including recreational catches in the SPA was questioned. These catches were not included in this year's assessment because of sampling and estimation problems noted in the presentation last year. These include extremely low biological sample sizes (often less than 200 fish measured per year) and difficulties in determining the catch by stock. Sensitivity analyses conducted last year indicated that the overall SPA estimates of F are not substantially altered by the inclusion or exclusion of the recreational catch at age estimates. These conclusions should be repeated and presented in the present assessment document.

- **It was recommended that a description of the sensitivity analyses performed to evaluate the influence of the recreational data on the SPA be presented in the assessment document.**

Discard of cod has been calculated by expanding computed discard/kept ratios obtained from sea sampling data to the total landings. Discards of cod were substantially less than for haddock and it was noted that this was due to the lack of trip limits on cod.

Resource Status

It was noted that **surveys** indicate relatively high abundance during the mid-1970s when Canadian catches were relatively low. If abundance was high, why were catches in the Canadian fishery so low? It was suggested that the spatial distribution of the stock may have shifted to the west and thus unavailable to traditional areas fished by the Canadian fleet. The question was then raised as to whether the survey accurately reflected abundance over the whole range of the stock, or whether the stock was primarily distributed in the western part of its range and the high indices may have reflected only part of the distribution of the stock. This question could not be resolved at this meeting and it was suggested that spatial plots of the survey data during the 1970s may address this question next year.

- **It was recommended that an examination of the spatial distribution of the resource be undertaken to understand historical fishing fleet behaviour.**

The year and age range chosen for this analysis reflect sample data availability and the ages which account for significant catches over the period of the assessment. It may be possible to expand the **calibration block** in the ADAPT formulation by including a plus group index beginning at a relatively low age, i.e., about age 5+. This was not a formal recommendation but rather a suggestion for exploratory analysis.

There was a sense that the **SPA results** reflect an overly optimistic picture of stock status. This view was supported by several observations including: 1) an inconsistency between recent

estimates of low F from the SPA and continued high estimates of Z from surveys, 2) possible inconsistencies in the age range used to portray average F(4-8) and the distribution of F at age in the most recent years (higher F at age 3 in 1996 and 1997), and 3) a tendency in recent years to underestimate terminal F. A re-analysis of total Z from the surveys performed by the TRAC indicated similar trends as the original analysis, i.e., the decline in F evident in the SPA was not detected by the survey data in the final year. The TRAC indicated that one high survey value may be influencing the survey Z and suggested that further analysis is required to better define the period to be used when computing average Z values.

- **It was recommended that analyses be undertaken which allow examination of Z trends in the surveys for comparison with the SPA estimates of mortality.**

It was noted that the choice of the age range used to portray average F may affect the perception of the trend in F in recent years. **Fishing mortality** on the younger ages is not declining as fast as F on the older ages. Is this an effect of changing catchability resulting from changes in the spatial distribution of the fishery in response to management measures, and the gear types currently in use? Biomass has increased in recent years due almost entirely to growth of existing year classes, particularly those of 1992 and 1993. Future growth will depend more on the younger ages, and the TRAC noted that F appears to be higher on these year classes compared to the older fish. The age range of cod used to portray average F was changed by the TRAC from 4-8 to 3-6 and results indicated that trends in unweighted average F based on ages 3-5 and 4-5 were similar to the ages 4-8 average, except for recent years where the average Fs based on ages up to age 5 were slightly lower in 1993 and 1994 and slightly higher in 1997.

An analysis performed by the TRAC using XSA with weak **shrinkage** corroborated the retrospective pattern in F, and reduced the larger differences noted in the ADAPT analysis. It was suggested that recent management measures implemented in the US zone since 1995, especially the permanent closed areas and recent shifts in the proportion of the catch by gear, may have an effect on the availability of younger ages in the stock to the fishery.

It was suggested that further improvements in the determination of current stock status relative to historic levels can be achieved by employing models which incorporate survey data from periods prior to the availability of data included in the VPA.

- **It was recommended that assessment models be explored that allow quantitative use of the historical fishery and survey information.**

The impact of **closed areas** on the estimation of relative abundance from surveys was noted. It was suggested that the survey stratification scheme could be re-configured to account for the permanent closed areas. This may reduce the variance on the estimates of relative abundance by taking into account the higher density of cod within the closed areas.

- **It was recommended that the potential for re-stratification of the USA survey, to account for the effect of the permanent Georges Bank closed areas on the abundance indices derived from the surveys, be examined.**

Outlook

Yield per recruit analyses were performed with varying age ranges and plus group configurations. It was concluded that most estimates of yield per recruit changed little if the mean weight of the plus group is determined accurately.

The TRAC discussed the selection of the estimate of the **size of the 1997 year class** at age 1 (0.4 million fish) for use in projections. Given the CV estimate on this parameter in the SPA (0.51) and the magnitude of the survey indices from the USA autumn 1997 survey and the Canadian 1998 spring survey for this year class (lowest since 1978), the TRAC concluded that this estimate of recruitment was appropriate.

The TRAC requested **additional analyses** to be presented at this meeting including: an update to the retrospective analysis through 1997, a correlated error model structure, additional analyses of surveys Zs, reconstruction of average F plots from SPA and surveys Zs, a projection run from the ASPIC model, and additional analyses of age-structured estimates of MSY reference points from the Sissenwine/Shepherd production model.

The **retrospective pattern** indicated a tendency to underestimate F in recent years, but no consistent patterns were evident for recruitment. The three surveys included in the SPA calibration exhibited weak correlation among ages within year and the TRAC concluded that the correlations are sufficiently low that there would be little benefit in applying a SPA model with correlated error structure for 5Z+6 cod. Trends in unweighted average F based on ages 3-5 and 4-5 were similar to ages 4-8 average, except for recent years where the average Fs based on ages up to age 5 were slightly lower in 1993 and 1994 and slightly higher in 1997. The TRAC discussed the merits of weighted vs. unweighted average F for this stock and concluded that the average F in the terminal year should be calculated in the same manner as the F on the terminal age, i.e, using the Z calculation from the age 4-8 survivors. This method produced an average F in 1997 of 0.28.

The **ASPIC model** reproduced biomass trends provided by the SPA and corroborated the recent increase in biomass. The analysis of equilibrium reference points using the Sissenwine/Shepherd production model approach was considered preliminary and the TRAC suggested that further analysis of the Beverton-Holt stock-recruitment relationship and the inclusion of additional data points would be desirable to better define the lower range of SSB and recruitment.

At the end of the deliberations on this stock, the TRAC accepted the analysis as presented.

5Zjm Cod
(Rapporteur: J. Neilson)

The assessment was presented by Maria Buzeta for Joe Hunt who could not attend. Comments below reflect the discussion which followed presentation of the results

The Fishery

It was mentioned that no miscellaneous **catch** category was available. Scallop draggers were thought to have groundfish landings, but this is unquantified. Scallopers are not allowed to retain groundfish, thus there are regulatory discards. Industry considered that discarding of groundfish is minimal. This was substantiated by observations from at sea sampling and port sampling. It was noted that the landings of miscellaneous gear have been slight in the past (perhaps one to three percent).

It was queried how the information on the **precision of aging** was used. The precision and biases checks were not directly incorporated into the assessment, but are used as a measure of reader performance. The possibility of including age information into the assessment was then discussed. The matchup of ages to lengths was discussed. It was clarified that length information was available for every fish aged.

The **catch at age** was compared to that from the 5Z+6 assessment. It was questioned if the nature of the fishery could explain the presence of smaller fish in 5Z+6. A seasonal component was noted, with the 5Z fishery starting earlier. There were comments that there are differences attributable to gear.

There was a request to see the **size frequency** information for the 5Z fishery. However, lack of samples for some US fisheries make it difficult to compare size composition by gear type in this fishery. The Canadian fishery captures older, larger fish. A discussion of the gear composition of the 5Z fishery ensued.

Resource Status

The distribution of sets on the **Canadian survey** was discussed. A question on the maturity distribution was raised: could fish have spawned and moved outside the survey area? The distribution of maturity stages was similar in 1998 to other recent years. Also, no strong environmental signals have been identified.

Further to the question of cod distribution, it was mentioned that there were no catches at the margins of the survey. If such catches were observed, it might lead one to believe that more fish are outside of the survey area. The linkage of the resource with cod in the deepwater and Georges Basin was discussed at length. It was noted that the USA spring and fall surveys cover the deep water of Georges Basin.

Survey catchabilities (Q) between the two assessments were compared. When proper quantities were compared, (Appendix III, Table 2 in the 5Z+6 assessment), they did not show similarities. It was concluded that some differences were expected, as differences in catchabilities were related to different fish densities in the two management units.

Comparing survey weights at age to fishery weights at age indicated that fishery age 5 cod may not be fully recruited.

Trends in biomass differ from this year's to last year's assessment. This is at least attributable to the use of survey weights for the first time. How consistent is this year's assessment to last year's? It was suggested that it would be useful to focus on population numbers to compare the assessment results. There was clarification of the perception of the 1995 year class. It is now considerably weaker than last year. The persistence of the 1992 year-class was noted. Population numbers this year were compared with last year. Population numbers in 1998 are about 10-15% lower now.

The **fishery catch weights** were smaller than those used in last year's assessment. A question was raised on the declining weights at age. The reliability of age determinations was questioned, and the impacts of aging error in the catch at age were discussed. Work to be completed during the meeting included examination of Z's from surveys.

- **It was recommended that exploitable biomass by gear type be determined to attempt to reconcile assessment results with industry perceptions of improved abundance in certain size classes (for longline gear).**

Outlook

The discussions of appropriate weights to be used in the projection dominated this section. A follow-up question queried if the mean weights from the survey underestimated the weights for the projections. Weights at age seem to be correct, but the pattern in the survey seemed problematic. 1998 weights at age in the survey appear particularly low.

This is a more pessimistic assessment than in 1997. At a combined 1998 Canada/US quota of about 3000t, there is a 12 percent risk of exceeding $F_{0.1}$, and an almost neglible risk of not achieving a 10 percent increase in biomass. However, there is a 53 percent risk of not achieving a 20 percent increase in biomass, unless the combined Canada/US quota is below 3000t.

The implications of forcing a flat-topped partial recruitment curve were discussed. Forcing a dome shaped relationship implies higher reference points. Why not use a selection pattern directly from the SPA? It was responded that this was an issue of consistency. The Yield per recruit analyses would have to be redone.

- **It was recommended that the implications of different partial recruitment patterns in the projections be examined.**

For the **projection plots** (biomass change), it was suggested to include a projection at zero. To assist with the interpretation of the assessment, it is important to look at changes in abundance by size. Abundance of large cod to the fishery may actually improve in 1998.

Comparison of Assessment Results for the Two Management Units

There was a discussion on whether there is consistency in year class strength between the two management units. Last year's comparison indicated there was no trend in the ratio. A question arose whether the age composition of the catch would then be expected to be similar. Responses centered around the 1992 and 1993 yearclasses, which were similar in both areas, but 1995 appears to have arisen in 5Zjm. Would this be related to an anomalous F value, given some anomalous F values noted in the the 5Z assessment? It may be that anomalous ratios could be diagnostic of a problem in the analysis. It is important to resolve this from a forecast perspective.

At the end of the deliberations on this stock, the TRAC accepted the analysis as presented.

5Z+6 Haddock
(Rapporteur: S. Correia)

The assessment was presented by Russell Brown. Comments below reflect the discussion which followed presentation of the results

The Fishery

The merits of using **survey mean weights** at age to calculate spawning stock biomass were discussed. A temporal shift in the US fishery to the third and fourth quarters is partially responsible for an increase in the commercial mean weights at age in recent years. These mean weights at age are greater than the weights occurring during spawning season due to growth. The TRAC suggested using NMFS spring survey mean weights in order to reduce this bias because the survey occurs during the peak of spawning season. However, the current SURVAN analysis program cannot directly estimate mean weights from the survey length frequency, length-weight equation, and age-length key. Estimating mean weight at age by applying the length-weight equation to the mean length at age from the SURVAN output can result in biased estimates of mean weights because weight is not a linear function of length.

- **It was recommended to use commercial mean weights at age for stock weights this year, and use survey mean weights at age for stock weights when the assessment is updated.**

The use of VTR (**vessel trip reports/ logbooks**) data to estimate discards in the US fishery in recent years was discussed. Questions about the reliability of VTR data were raised relative to fishermen over-reporting discards because of dislike for regulatory discarding caused by trip-

limits. Comparisons of same trip sea sampling information with VTR suggest that over-reporting is not problematical, but this agreement between VTR and sea sampling data may be an observer effect. A second discard related issue concerned a possible lack of independence between survey catch at age and total catch at age because survey indices were used to estimate discards for the 1974, 1977, 1978, and 1980 catches and also tune the SPA.

The method used to estimate total **discard** by raising the sample discard/landings ratio by total landings was discussed. A study in Europe showed that discard estimates derived using ratio of discards to landings for small sample sizes were noisy and biased. The ratio of discards per trips raised by total number of trips provided better results. However, discards in the US fishery are concentrated spatially and temporally, therefore, given the fleet behavior, the sub-trip level may be a better unit for expansion than trips.

- **It was recommended to investigate other ratio estimators for estimating discards.**

A suggestion was made to project discards for 1998. However, projecting discards will be difficult because they are mostly a function of trip limits, which will vary during the year. Currently, discards comprise 10-20% of the total catch, and since much of the discards are caused by trip limits and cover all ages, they may not have a large impact on the assessment. The TRAC requested a sensitivity run with no discards to evaluate the impact of the discard estimate on the assessment. Results of the sensitivity run are reported below. Managers should be made aware of the increased need for sea sampling in order to characterize length and age composition of discards.

Length and age sampling of the USA fishery needs to be improved, especially in the spatial and temporal coverage. Alternate sampling designs for gathering biological information should be investigated. Size distribution by quarters should be examined for suitability for pooling for years with inadequate sampling.

- **It was recommended that there be improved length and age sampling of the US fishery, particularly the spatial-temporal component. An increase in sea sampling will be needed to characterize the discard portion of the catch, especially if an increase in regulatory discards occurs. Alternative sampling designs for gathering biological information should be investigated.**

Resource Status

The TRAC discussed **errors in the survey catch at age matrix**. A concern was raised over the treatment of zeros in the tuning indices as missing data. An argument was made that zero data points contain information and treating the points as missing data may create bias. Several approaches were suggested, including adding a constant prior to ln transformation. Another approach mentioned was to calculate a survey index using 1 fish as the total survey catch. This led into a discussion of the assumption of independent and identically distributed errors in the survey catch at age. A research recommendation was proposed to examine the use of a

multinomial error for the survey catch at age. The TRAC also suggested that for either error structure, pooling of adjacent year classes may be beneficial.

- **It was recommended to examine the effects of treating zero survey data as missing values and develop methods to include "zero" data points.**

- **It was recommended that to explore the use of multinomial error structure in the catch at age matrices.**

The TRAC compared results from **exploratory ADAPT** analyses using log-normal or multinomial error structure. The assumption of error structure affects the estimates of current stock numbers with assumption of multinomial producing smaller numbers at age than the log-normal error structure. Based on examination of available diagnostics, the TRAC could not differentiate one error structure assumption as superior to the other. The multinomial may be useful for small values and handling year effects, and the log-normal may handle large values better. Neither error structure appears to be robust enough to fit the data. The TRAC suggested that the direction and magnitude of the difference in results from the two models be incorporated in the uncertainty section of the Advisory Report. These minor differences caused by model mis-specification cannot be resolved and is another source of uncertainty.

A discussion ensued on the use of **weighting** of tuning indices. Iterative re-weights of tuning indices were examined in previous haddock assessments, but concerns were raised about the effects of using series of various lengths, especially when the tuning sets includes a short time series. The TRAC suggested that weighting of tuning indices should be re-explored.

The issue of door/vessel/net changes effects on **catchability** estimates was discussed. The residual pattern seen in previous assessments may be due to the effect of net change rather than poor estimates of door/vessel conversion factors. Comparative fishing experiments between the Yankee 41 and Yankee 36 produced insufficient data for calculating a net conversion factor for haddock. However, comparisons of survey catchabilities from the ADAPT output showed evidence of differential catchabilities. This led to the adoption of splitting the US spring time series into two series based on net use.

A suggestion was made to present survey age indices with CV's in the technical report. Another suggestion was made to bootstrap raw survey data and age-length key to characterize variance in survey data. However, bootstrapping would have to occur at the stratum level and sample size within a stratum may be too small for bootstrapping.

The assumption of flat-topped partial recruitment for estimating **F on terminal ages** was discussed. An alternative model to remove the constraints on terminal F and directly estimate terminal age survivors was suggested. This model removes constraints on terminal F by calculating catchability for older tuning indices as an average of catchability of some younger ages. A concern was raised that fixing catchability for older ages may result in stock sizes that

are not well determined. In addition, there were no evidence that the fishery had a domed-shaped partial recruitment.

- **It was recommended that to examine the impact of fixing the F on terminal ages.**

A **sensitivity run** in which q was fixed for the Canadian 3+ indices to free the terminal age F assumption was compared with the standard ADAPT run. Results were similar and suggest that the assumption of flat-topped recruitment , i.e., calculating terminal age F as an average of F's from fully recruited younger ages was reasonable.

A drop in **catchability** of the older ages in the US Fall survey was noted. This survey may be more useful for tuning the younger ages. A sensitivity run was made that dropped US Fall ages 2,3,4 and 5 from the 5Z+6 assessment. Diagnostics indicated the model did not fit as well with higher CV's on the terminal year estimates and increased mean square error. Stock numbers increased approximately 10-15% and the average unweighted F (ages 4-7) declined to around 0.09. Spawning stock biomass increased 6,000 mt from the base run. Given the degradation in model diagnostics, the TRAC decided that the base run was superior to the sensitivity run.

The issue of whether to **bias correct** population estimates was discussed. Bias correction was explained as a method to better estimate the probability distribution around estimates for assessing risk. The bias is caused by non-linearity relationships in the model and is analogous to the bias of geometric mean to the arithmetic mean. A presentation on bias correction and various techniques to bias correct was made at a special session of the TRAC (see section on bias correction presentation).

- **It was recommended that the issue of bias correction and methods to bias correct be explored.**

Two **sensitivity runs** were made to remove discards from the catch at age. The first run removed discards from the 1974, 1977, 1978 and 1980 catches (discards due to yearclass effect and minimum sizes) and 94-97 (discards due to trip limits). The second sensitivity run eliminated only the 1994-1997 discards. No significant change in diagnostics occurred in either run. The removal of discards did not change stimates of SSB. Average F declined slightly in the terminal year (0.11 to 0.09) and increase slightly in 1993. Recruitment estimates did not change much with the exception that removal of 1970's discards from the catch at age gives a less optimistic view of the 1972, 1975 and 1978 yearclasses. Given that there is strong evidence for discarding in both periods, the TRAC endorsed leaving the discards in the catch at age.

A **retrospective** pattern in the 5Z+6 assessment was apparent with a tendency to overestimate terminal F's and underestimate spawning stock biomass in the terminal year. This retrospective pattern improved following declines in fishing mortality rates after 1994. The retrospective pattern in F may be an artifact of using an unweighted average F to characterize terminal fully recruited F's. Noisy retrospective patterns were also observed for some recent cohorts. This may be due to the effect of a single large tow on the 1996 survey index and results in a year

effect for 1996 spring survey. This tow is outside the strata set used to construct the survey index for the 5JM assessment.

Results from an **exploratory XSA** model with shrinkage applied to 1996 data were presented. Assessment results showed no retrospective pattern in contrast to the retrospective pattern seen in the 1996 5Z+6 assessment. Based on recommendations from the TRAC, the XSA model was re-run excluding the shrinkage feature. Once the XSA model shrinkage feature was removed, a retrospective pattern similar to the ADAPT retrospective pattern emerged.

The **yield per recruit** was not updated for the 5Z+6 assessment. A plus group of 15+ was used in the 5Z+6 assessment and a 16+ group was used in an updated yield per recruit in the 5JM assessment. This was not thought to impact results. The slight differences in the YPR between the two assessments was thought to be a function of slightly different partial recruitment and mean catch weight at age vectors.

Outlook

The TRAC discussed various methods for developing **biological reference points** to meet the USA's Sustainable Fisheries Act (SFA). A scatter plot of SSB and recruitment suggests that recent productivity is lower than that seen for the time period prior to 1960. Several issues regarding the construction of the stock-recruit plot were raised. Mid-year fishery mean weights, backed to January 1 using the Rivard method (Rivard, 1982) were used to estimate SSB from the current assessment while first quarter fishery mean weights were used to estimate the SSB from the Clark et al (1982) assessment. Although fishery mean weights are biased high compared to population weights in recent years, the fishery mean weights in the 1930-1960 period are probably close to stock weights because of the behavior of the fishery. A concern about uncertainty in the maturity ogive during the earlier period, and the uncertainty about the success of first time spawners was raised. Given these uncertainties, the TRAC suggested exploring the use of age 3^+ biomass as a proxy for SSB. This led to a discussion of whether the stock is at a new, lower level of productivity, or whether recruitment will improve with increases in SSB. Whether recent recruitment is constrained by a new productivity regime has implications for setting rebuilding targets and time frames for rebuilding. Unless productivity returns to pre-1960's levels, SSB targets may not be reached. An analysis presented at the meeting suggested that SSB targets are unlikely to be reached under current levels of SSB and fishing mortality. Results from an analysis not presented at the meeting suggested that SSB may increase, albeit very slowly, at the target $F_{0.1}$ mortality rate (ICES 1997).

The TRAC discussed methods to estimate biomass and fishing mortality rate **thresholds to meet SFA requirements**. The ASPIC surplus production model cannot account for the dynamics of the haddock stock, even if the time series is separated into a 1930-1963, and 1963-1997 periods. It was suggested that estimating Bmsy may not be possible for this stock and proxies may have to be used to meet SFA guidelines for targets and thresholds. Several proxies were suggested such as applying median recruitment for a specified time frame to a yield/biomass per recruit model or selecting biomass levels during the period of high productivity. The level of B_{msy} will depend on assumptions about the current productivity regime. More time will be needed to see

whether the stock can regain its former productivity. The TRAC concluded that in the interim there was no basis to change the 80,000 mt SSB threshold.

- **It was recommended that spawning stock biomass estimates in future assessments should be estimated using fishery-independent estimates of mean weights at age.**

At the end of the deliberations on this stock, the TRAC accepted the analysis as presented.

5Zjm Haddock
(Rapporteur: L. VanEeckhaute)

The assessment was presented by Stratis Gavaris. Comments below reflect the discussion which followed presentation of the results

The Fishery

It was mentioned that the Canadian **landings** database could be used to look at species composition in order to gain insight into discarding. An analysis should keep in mind that fishermen may change the species directed for on a day by day basis. Industry noted that fishermen are more willing to fill in log books now than they were in the past.

The fishery **catch rates** were low for June, which is a change from what is usually seen. Industry observed that haddock were not in their traditional areas in June and longline fishermen had a problem with dogfish. The July fishery found haddock in the deeper waters. There was interest from industry in what is happening in the closed area in June. The monthly catch records for the USA fishery since 1985, when that area was being fished by the USA shows that after July, the catch drops rapidly.

Clarification on how USA **discards** for the 1975 and 1978 yearclasses were estimated was asked for. These were estimated from survey data and interviews. There is some concern over the resulting circularity in the analysis but it has been shown that leaving out the values in question from the analysis does not have a large effect. Exploration of discarding in earlier years by using an assessment model which estimated a reporting ratio indicated that the 1975 and 1978 yearclasses may have been more abundant. Canadian quotas were not restrictive until 1994 and few undersized haddock were caught in the fishery so there was no regulatory incentive to discard. Discard estimates could be projected for 1998 to improve our perception of discards, as has been done by the Europeans. This however would be difficult to do here as discarding is related to USA trip limits which change. A better estimate of discards than using a weight-based ratio may be to use trip expansion and not catch to determine the discard ratio. Attempts may be made to study the discarding pattern to find the best way to estimate them but the pattern will change due to changes in the trip limit and other factors. The discarding pattern is very variable and affected by area fished, month, etc. It is possible that USA discards may be overestimated but investigation of this by the USA assessor indicated that this did not seem to be a problem as

different ports and observers all showed high discard rates. To assess the impact of the discards, a sensitivity test which leaves out discards was requested. (see report on 5Z+6 haddock). The uncertainty surrounding the discard estimate does not have much effect in the 5Zjm assessment as USA landings are so low.

There was concern over using **length frequencies** across gear sectors for the USA landings. USA landings are stratified by market category and this minimizes some variability. The categories are market driven and vary somewhat from day to day but have been shown to be fairly consistent over time. Market categories are not used in the DFO analysis. There is a database which contains size category information, though it may not be complete, but sampling occurs before this sorting process occurs.

Resource Status

As with 5Z+6 haddock, results from analyses using **alternative objective functions** (i.e. assumptions regarding error structure of survey data) were presented. In particular, the uncertainties associated with two model assumptions (a multinomial and log normal comparison) were considered further. Results from these models showed that the terminal estimates only were affected and not the whole trajectory of the stock by either being shifted up or down. This would be expected because of the effect of convergence of the VPA. With regard to the assumption that the logarithm of survey observations for small catches are as reliable as for large catches, the model which placed less emphasis on small catches resulted in a 40% lower estimate of population abundance in 1998. The results from the alternative model displayed some unusual diagnostics and were considered illustrative, but further investigation of models, which place more or less reliance on particular observations, was suggested. These analyses produced substantial differences and diagnostics to help discriminate between them should be investigated. It was observed that changing the error assumptions does give further insight into the data. Model mis-specification can cause large differences in the perception of the status of a stock and this should be stated in the uncertainty section of the stock status report.

Results from an **ADAPT** formulation assuming log normality but going forward in time to get away from the assumption that fishing mortality on age 8 was equal to the average on ages 4 to 7 were presented. Similar results were obtained using this model so the assumption on terminal F was considered appropriate.

An alternative to omitting "zero" survey values from a calibration run would be to add a value to each. The problems with adding a value and how to determine what to add were debated.

Although variation in natural mortality was not examined, alternative analyses with survey data indicated that the level of total mortality was consistent with SPA but annual patterns did not coincide. These alternative analyses also did not indicate the reduction in fishing mortality since 1995 that was obtained by the SPA.

Ways to **weight the indices** such as using the standard error from the stratified mean, the average residual or the CV's by age and survey were suggested. There is a problem with the difference in

length of the time series in using average residuals and a problem with strong skewing in the data. The variance may not be well characterized, especially for the NMFS surveys where sample sizes within strata are small.

The **variability in the F matrix** over ages was questioned. This may be due to sampling variation. A model that assumes random errors in the catch could be pursued at a later date.

- **It was recommended that alternative models be considered in a venue more appropriate than this meeting as there are others who should provide their expertise.**

A multiplicative analysis of the NMFS spring survey with the NMFS fall survey catches at age for the younger ages corroborated the difference in **catchability** for the Yankee 36 versus the Yankee 41. It was questioned whether the door conversion for the NMFS surveys should be addressed by shortening the surveys to exclude the period when the other door was used. It was pointed out that comparison of the catchabilities from the fall survey did not show a conclusive difference for the doors whereas the comparison for the spring survey was more apparent. The greater difference for the spring survey was caused by the change in the net from 1973 to 1981. This was addressed by treating these years as a separate survey.

The **US fall survey** catchabilities are fairly high for age 1 and the older fish have low catchabilities for this survey. This had been noted in this assessment and results in many zero values for the older ages. Therefore, the older ages (6,7) are not used in the tuning of the 5Zjm assessment. A sensitivity run for the 5Z+6 assessment which leaves out the older ages and uses the fall index as a recruitment index was requested. (see 5Z+6 haddock report)

A **retrospective pattern** was observed for 5Z but not for 5Zjm. Also, the XSA analysis used by European assessors did not produce a retrospective for 5Z+6. As it was difficult to compare the retrospective presentation for the 2 assessments, a "spaghetti" type plot of biomass and F for the 5Zjm assessment was requested. The resulting biomass plot did not exhibit much of a pattern. The retrospective patterns for the weighted and unweighted 4+F's also did not exhibit any disturbing trends. Weighting of F gives more weight to the younger fish as they make up a larger portion of the catch. The lack of a retrospective pattern in the XSA analysis for 5Z+6 haddock may be due to the use of "shrinkage". Turning off shrinkage in this analysis produced a retrospective pattern as was seen using ADAPT. (see also the 5Z+6 haddock report)

Outlook

There was a slight difference between the deterministic projection results and the probability plot which is due to how the parameters are **adjusted for bias**. This topic was investigated further as it applied to all the assessments and is discussed in the section on bias above.

The slope of the lines representing the **probability** of not achieving a certain percent increase in biomass in the risk plot compared to the slope of the line representing the probability of the 1998 F being exceeded was questioned. The F curve represents F on ages 4+ while the biomass

curves are for ages 3+ which includes the less precisely estimated 1996 yearclass in 1999 and probably accounts for the difference in slope. A plot using ages 4+ for biomass change should have a slope more similar to the F line slope. This was confirmed.

At the end of the deliberations on this stock, the TRAC accepted the analysis as presented.

5Zhjmn Yellowtail
(Rapporteur: A. Sinclair)

The assessment was presented by Steve Cadrin and John Neilson. Comments below reflect the discussion which followed presentation of the results

The Fishery

There has been significant **discarding** of yellowtail on Georges Bank. The USA estimates of catch include a discard portion. There are no discard estimates for the relatively new Canadian directed commercial fishery although discarding is not believed to be substantial. However, the Canadian scallop fleet was prohibited from landing yellowtail in 1996 and they have landed the species in previous years. While there were discard estimates available for the 1996 Canadian scallop fishery, they were not available in 1997. It may be necessary to establish protocols to estimate yellowtail discarding in the scallop fishery.

A potential **species and sex mis-identification** problem was identified in 1997 Canadian observer sea sampling of yellowtail. Industry representatives indicated that other flatfish species such as winter flounder and plaice are rare on yellowtail fishing grounds, and it was difficult to determine what species might have been misidentified as yellowtail. The Canadian observer coordinator has been informed of the problem and is aware that measures are needed to ensure adequate training of observers. While substantial quantities of flatfish were reported as unspecified species in Canadian landings is past years, this is being addressed and is now a relatively minor problem. A total of 13 t of unspecified flounders were reported in 1997, and 9 t were estimated to be yellowtail.

Concern was expressed about **sampling levels** being insufficient to capture spatial and temporal variation in the fishery. The 1997 Canadian sampling covered all months and the fishery is clumped in a relatively small area. Temporal coverage of the 1997 USA sampling is lacking with a paucity of samples in the second half of the year.

Some concern was expressed about yellowtail **age determinations**. Plans are being made to begin aging the species in Canada, but in the mean time USA research vessel age data are being applied to Canadian landings and surveys. The lack of yellowtail less than 30 cm in the USA landings, and their presence in Canadian landings, required using USA survey and commercial ages to estimate Canadian landings at age. These uncertainties may explain the difficulty in following year-classes in the commercial catch and Canadian research vessel survey results. Plans are currently being made to include yellowtail in an aging workshop between USA and

Canadian labs. In addition to establishing aging protocols, the workshop should also consider age consistency check protocols, and the results of these checks should be included in working papers for information. Results of the recent Canadian Maritimes Region aging workshop (DFO 1997) would be useful.

- **It was recommended that Canadian aging program for yellowtail be developed. Also, research is required on the use of otoliths as an aging structure.**

Yellowtail also show considerable **differences in size at age by sex** which may require some modifications to sampling and assessment procedures. The USA surveys collect aggregate length frequencies and use pooled-sex age-length keys . Using sexed length frequencies may increase the precision of catch-at-age estimates and would allow closer examination of differences in distribution between sexes. The SPA for the stock currently uses aggregate catch at age. However, differences in size at age and variation in fishing mortality over years is likely to result in systematic variation in population wide partial recruitment and weight at age. Differences in partial recruitment between sexes affects estimates of SSB/R and age-based MSY estimates. Separate analyses by sex may alleviate this problem. The implications of doing aggregate vs. separate SPA analyses should be investigated with simulation.

- **It was recommended that the implications of doing sex-aggregated vs. sex-separated SPAs be investigated with simulation. Consideration should be given to the precision of stock size estimates, possible confounding of population wide and sex-specific partial recruitment and weights at age, and the costs associated with doing essentially two SPAs.**

Some concern was expressed about the apparent high **total mortality** of yellowtail in the research vessel time series and the lack of older fish in the commercial catch. While this may simply reflect heavy exploitation of the stock up to the mid-1990s, it could also result from underestimation of the age of the fish or from the current sex-aggregated length frequency sampling program. The addition of new Canadian age data and use of sex-separated samples may cure the problem and this should be investigated.

Resource Status

There was a high degree of agreement among the various quantitative and qualitative indices of the status of yellowtail flounder an Georges Bank. **The SPA (ADAPT) and production analyses (ASPIC)** indicated increasing stock biomass and a recent decline in fishing mortality. Analyses using extended survivors (XSA) and separable VPA produced similar results. The increase in stock biomass is due mainly to growth of survivors and recent recruitment appears to be low. This was confirmed by comparison of survey length frequencies from the 1960s, when yellowtail less than 30 cm in length were very abundant, to those from recent years where fish of these sizes were almost absent from the surveys. The decline in fishing mortality is consistent with the decline of fishing effort associated with the closure of area II in USA waters and a reduction of the Canadian landings. Trends in total mortality estimated from survey results on their own also indicated a recent decline with magnitudes similar to those estimated with SPA.

The lack of **recruitment** caused some concern about using ASPIC projections of stock abundance. However, a retrospective analysis of the ASPIC results suggested short term projections have not overestimatedc biomass, at least in recent years. It was agreed to present results of both projections.

Outlook

Indices and models indicate the stock is increasing and improving. However, improved recruitment is required for continued rebuilding.

At the end of the deliberations on this stock, the TRAC accepted the analysis as presented.

References

Clark, S.H., W.J. Overholtz. and R.C. Hennemuth. 1982. Review and Assessment of the Georges Bank and Gulf of Maine Haddock Fishery. J. Northw. Atl. Fish. Sci. 3: 1 - 27.

DFO. 1997. Inter-regional Ageing Workshop. CSAS Proceedings 97/18.

ICES. 1997. Report of the Comprehensive Fishery Evaluation Working Group. ICES CM 1997/Assess:15.

Rivard, D. 1982. APL Programs for Stock Assessment (revised). Can. Tech. Rep. Fish. Aquat. Sci. No. 1091.

Appendix I. List of Participants

Canada/US Transboundary Resources Assessment Committee (TRAC)
20-24 April 1998, St. Andrews, New Brunswick

List of Participants

Participant	Affiliation/Address	Telephone	Fax	E-Mail
Alan Sinclair	DFO, Moncton, Canada	506-851-2721	506-851-2620	sinclaira@mar.dfo-mpo.gc.ca
Ana Parma	IPHC, Seattle, USA	206-634-1838	206-632-2983	ana@iphc.washington.edu
Bob Mohn	DFO, Dartmouth, Canada	902-426-4592	902-426-1506	mohnr@mar.dfo-mpo.gc.ca
Bob O'Boyle	DFO, Dartmouth, Canada	902-426-3526	902-426-5435	oboyler@mar.dfo-mpo.gc.ca
Brian Giroux	SFMGFA, Canada	902-742-6732	902-742-6732	Sfmobile@fox.nstn.ca
Emory Anderson	NMFS, Woods Hole, USA	508-495-2317	508-495-2393	emory.anderson@noaa.gov
Evan Walters	SFIFA	902-745-3134	902-637-3270	sfifa@klis.com
Gary Melvin	DFO, St. Andrews, Canada	506-529-8854	506-529-5862	melving@mar.dfo-mpo.gc.ca
Gloira Poirier	DFO, Moncton, Canada	506-851-2035	506-851-2620	poirierg@mar.dfo-mpo.ga.ca
Heath Stone	DFO, St. Andrews, Canada	506-529-8854	506-529-5862	stoneh@mar.dfo-mpo.gc.ca
Jean Guy d-Entremont	Inshore Fisheries Ltd., Canada	902-762-2522	902-762-3464	inshore@atcon.com
Jean-Jacques Maguire	1450 Godefrey, Sillery, Canada	418-688-5501	418-688-7924	JJ_Maguire@compuserve.com
John Neilson	DFO, St. Andrews, Canada	506-529-8854	506-529-5867	neilsonj@mar.dfo-mpo.gc.ca
Jon Witzig	NMFS, Gloucester, USA	978-281-9232	978-281-9161	JohnWitzig@noaa.gov
Jorgen Hansen	DFO, Halifax, Canada	902-426-9046	902-426-9683	hansenj@ mar.dfo-mpo.gc.ca
Julie Porter	DFO, St. Andrews, Canada	506-529-8854	506-529-5862	porterj@ mar.dfo-mpo.gc.ca
Leszek Bruno Prenski	INIDEP, Mar del Plate, Argentina	0054 23 862586	0059 23 862586	bprenski@inidepoedu.ar
Loretta O'Brien	NMFS, Woods Hole, USA	508-495-2273	508-495-2393	lobrien@whsunl.wh.whoi.edu
Lou Van Eeckhaute	DFO, St. Andrews, Canada	506-529-5938	506-529-5862	Van_EeckhauteL@mar.dfo-mpo.gc.ca
Marie Buzeta	DFO, St. Andrews, Canada	506-529-8854	506-529-5862	buzetam@mar-dfo-mpo.gc.ca
Maureen Yeadon	FRCC, Canada	902-852-3005	902-852-2756	myeadon@ns.sympatico.ca
Michael Power	DFO, St. Andrews, Canada	506-529-8854	506-529-5862	powerm@mar.dfo-mpo.gc.ca
Mike O'Connor	National Sea Products, Lunenburg, Ca.	902-634-8811	902-634-4926	oconnorm@natsea.ca
Ralph Mayo	NMFS, Woods Hole, USA	508-495-2310	508-495-2393	ralph.mayo@noaa.gov
Rob Stephenson	DFO, St. Andrews, Canada	506-529-8854	506-529-5862	stephensonr@mar.dfo-mpo.gc.ca
Robin Cook	FRS Marine Lab, Aberdeen, Scotland	+44 1224 295923	+44 1224 295511	cookrm@marlab.ac.uk

Participant	Affiliation/Address	Telephone	Fax	E-Mail
Ronald Clark	DFO, St. Andrews, Canada	506-529-5909	506-529-5862	clark@mar.dfo-mpo.gc.ca
Russell Brown	NMFS, Woods Hole, USA	508-495-2380	508-495-2393	Russell.Brown@noaa.gov
Steve Cadrin	NMFS, Woods Hole,USA	508-495-2335	508-495-2393	steven.cadrin@noaa.gov
Steven Correia	MDMF, Pocasset, Mass., USA	508-563-1779	508-563-5482	Steven.Correia@state.ma.us
Stratis Gavaris	DFO, St. Andrews, Canada	506-529-5912	506-529-5862	gavariss@mar.dfo-mpo.gc.ca
Tim Nickerson	SFIFA	902-768-2535	902-768-2259	
Vivian Haist	DFO, Nanaimo, Canada	250-756-7205	250-756-7138	haistv@pbs.dfo-mpo.gc.ca

Appendix II. Description of the TRAC Process

Since the termination of ICNAF in 1977, Canada and the USA have independently developed peer review processes for their stock assessments. In Canada, in late 1992, the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) was disbanded and the Regional Advisory Process (RAP) put in its place. RAP in the Maritimes Region currently provides advice on about 120 marine and freshwater finfish, shellfish and marine plant resources in the DFO Maritimes Region. In the Northeast Region of the National Marine Fisheries Service (NMFS), the Stock Assessment Workshop (SAW) series was initiated in 1985. The SAW process currently provides advice on about 44 marine finfish and shellfish resources in the Northeast Region of NMFS.

Collaboration between Canada and the USA on stock assessments and related research has been strong. Regular scientific meetings are held to co-ordinate joint research programs and facilitate inter-lab communication. Protocols for routine data exchange, particularly commercial and survey, have been established and joint work on assessment related issues is common. Finally, participation in each other's peer review process is routine.

The 1996 Canada/USA Scientific Discussions noted that it would be desirable to conduct joint assessments of the Georges Bank groundfish stocks during the 1997 assessment cycle. Thus in April 1997, scientists from Canada and the USA combined efforts to prepare assessments of Georges Bank cod, haddock, and yellowtail flounder. The peer review of these assessments was subsequently conducted first by RAP in Canada and then by the SAW Stock Assessment Review Committee (SARC) in the USA. Upon completion of the 1997 process, it was evident that there would be efficiencies realised by eliminating the duplication in the peer review process. This would also ensure that RAP and SARC would not produce divergent and inconsistent status reports on these stocks.

In the fall of 1997, discussions were initiated between the two countries to define a joint peer review process. This report is the result of these discussions and outlines the new process.

A Joint Peer Review Process

Stocks to Consider

There has been close interaction between Canada and the USA on 5Z cod, haddock, and yellowtail flounder. Thus, these stocks will initially be the principal focus of the new process, although other stocks in the Georges Bank - Gulf of Maine region may also be considered (e.g., Southern New England yellowtail flounder, Gulf of Maine cod, Gulf of Maine - Georges Bank plaice, and Georges Bank winter flounder) in future years.

Structure of the Peer Review

Transboundary Assessment Working Group

A Transboundary Assessment Working Group (TAWG) has been established with membership composed of Canadian and USA scientists with a range of backgrounds and thus be multidisciplinary in nature. As well, industry participation from both countries are encouraged. Its mandate is to:

- analyze pertinent assessment information and produce stock assessments on identified stocks;
- formulate research recommendations which will lead to long-term improvements in the assessments.

Meetings of the TAWG are arranged on a mutually agreed basis by both countries. The Chair of the TAWG is determined by the RAP and SAW Chairs.

Transboundary Resources Assessment Committee

A new Transboundary Resources Assessment Committee (TRAC) has been established to peer review the stock assessments produced by the TAWG. The TRAC is distinct from RAP and SARC. The Committee is co-chaired by the Chairs of RAP and SAW who are responsible for all logistical arrangements associated with TRAC meetings (e.g., dates, venue, participation).

The TRAC is responsible for producing final, approved assessments and resulting documentation on the status of the transboundary resources.

Participation at the first TRAC meeting is by invitation and consists of no more than 8 - 9 Canadian and 8 - 9 USA representatives. The policy on participation at future meetings will be developed based on experience with the new process.

The TRAC will alternate its venue between Canada and the USA, with the host country serving as chair. The first meeting will be held in St. Andrew's, N.B., Canada 20-24 April 1998 and will be chaired by the RAP Chair.

TRAC Coordination

The RAP and SARC Chairs, with the guidance of their respective steering committees, oversee the activities of the TRAC and TAWG.

Management Advice and Public Meetings

Once the TRAC review process has completed its deliberations, the results may be used by either country for fisheries management purposes as appropriate e.g., preparation of management advice in Canada by the Fisheries Resource Conservation Council (FRCC) and in the USA by

the SARC. Each country may conduct independent consultations with clients or disseminate the information to the public, informing the other side as required.

Documentation

Technical Documents

For 1998, each country will catalogue the technical reports produced by the TRAC and the TAWG in their resspective technical document series. A policy for the cataloguing of future documents remains to be developed.

Stock Status/Advisory Documents

The purpose of the joint Canada/USA stock assessment process for transboundary resources is only to produce and peer review assessments of stocks of mutual interest and not to prepare management advice. The assessment results from this joint process will be used by each country for their respective fisheries management purposes. The document series currently employed by each country at RAP and SARC meetings to convey a brief summary of stock status and management advice for individual stocks (i.e., the DFO Stock Status Report series in Canada and the SAW Advisory Report on Stock Status in the USA) will continue to be used for those purposes in each country because they serve different purposes and clients in each country. For stocks reviewed at a given TRAC meeting, the TRAC will produce final, approved documents for the Canadian SSR series. These documents, as well as the technical documents noted above, will provide the basis for management advice to be prepared by the SARC, following the TRAC meeting, and reported in the SAW Advisory Report on Stock Status.
Meeting Remit

Appendix III. Report of the TAWG

The Transboundary Assessment Working Group (TAWG) met March 31- April 2, 1998 in Woods Hole, Massachusetts to assess the stock status of Atlantic cod, haddock and yellowtail flounder on Georges Bank. For the three species, five assessments were conducted: 1) Eastern Georges Bank cod (5jm), 2) Georges Bank cod (5Z), 3) Eastern Georges Bank haddock (5jm), 4) Georges Bank haddock (5Z) and 5) Georges Bank yellowtail flounder. The following participants attended all or some of the meeting: E. Anderson, M-I. Buzeta, G. Bolz, S. Cadrin, R. Brown, S. Correia, S. Gavaris, J. Hunt, R. Mayo, J. Neilson, P. Nitschke, P. Perley, L. O'Brien, K. Sosebee, M. Terceiro, L. Van Eeckhaute, and S. Wigley. Loretta O'Brien chaired the meeting and Susan Wigley served as rapporteur. Attached are the agenda and terms of reference for each assessment.

Generic topics discussed for all three species included fishery landings, abundance trends, current stock status, reference points and projections (see agenda). Below is a brief summary of the discussions.

Historical landings: There was general consensus that including historical landings in the current assessment document was beneficial, as it allowed current conditions to be put into a historical perspective. Inclusion of a commercial sampling summary of ages and lengths, along with an accompanying rationale of when and why each assessment starts when it does (i.e. for cod, commercial sampling was inadequate prior to 1978) was also considered beneficial.

Catch-at-age uncertainty due to lack of commercial sampling: For all three species, USA commercial sampling was lacking in either geographic coverage and/or quantity. For yellowtail flounder, the lack of temporal coverage and low quantity of commercial samples in the second half of the 1997 was extremely low; for cod and haddock, geographic coverage of the eastern portion of Georges Bank was minimal and overall quantity was poor. Without adequate numbers of length and age samples with appropriate spatial and temporal coverage, the derived catch-at-age will have uncertainty. Samples from other sources such as sea sampling trips are being utilized for haddock and yellowtail flounder; however, the sea sampling coverage is extremely low.

Discards and management: Regulatory discards (not discarding due to minimum size limit) are a growing source of uncertainty. Discard information (weight and length frequency) from the Canadian scallop fishery is needed for the yellowtail flounder assessment. For the haddock assessment, trip limits have caused regulatory discards, however sea sampling coverage (10 sea sampling trips occurred in 1997) is far too low to accurately calculate discard rates and length frequency data collected from these trips are too sparse to characterize the regulatory discards.

Fishery mean weights versus survey mean weights to derive spawning stock biomass: Diverging trends in spawning stock biomass (SSB) for haddock were detected. Consistency among assessments is needed in the derivation of SSB. The use of fishery mean weights to estimate SSB may overestimate SSB in that fishery mean weights may not characterize the whole population, i.e. the fishery may capture the big, faster growing fish. Survey mean weights

at age obtained by applying a length-weight equation to survey length distributions at age may be more appropriate, if survey data are adequate. The adequacy of survey mean weights at age as representative sample of the population must be addressed. For example, NEFSC surveys do not sample large yellowtail flounder well, and commercial mean weights are considered more representative of the population.

Abundance trends: Survey abundance trends should be displayed for all available years where the results are comparable to provide the longest possible historical perspective.

Two nets used in USA Spring survey time series: The USA spring survey used two nets during the time series; a Yankee 36 net was used for all years except 1973-1981 when a Yankee 41 net was used. The TAWG discussed how this time series should be handled, either as one series or as two separate series with the rationale that the two gear types should be considered different until proven they are similar. Although a conversion factor was estimated for yellowtail flounder, a comparison of the pattern of residuals from ADAPT and results from the standardization experiment suggests that the net conversion factor was too large. The group concluded that the USA Spring series would be treated as two separate time series until further analyses could be performed to either 1) fine tune the conversion factors associated with the net change or 2) to fully evaluate the changes in catchability through the spring time series. Sensitivity runs were conducted for each asses! sment which showed that whether the spring series was utilized as one or two series, the outcome of the VPA changed little because the VPA had converged before the change in nets. By representing the spring survey as two series only a small amount of precision is lost as a result of estimating a few more parameters. Further investigation is warranted to fully examine the issue of different gear use during the USA spring survey time series.

Ageing issues: In recent ageing exchanges between the USA and Canada, percent agreement has declined for both species. For cod, there was also an apparent directionality in the differences. To reduce uncertainty in the CAA, the TAWG recommends that an ageing workshop be conducted to address the declining percentage agreement issues for cod, haddock. For yellowtail flounder, Canada would like to develop ageing techniques, thus yellowtail flounder could be included in the workshop to develop consistent criteria and cooperative sample exchanges. Although there are apparent changes in mean weight at age for yellowtail flounder over the time series, there is no evidence to conclude there is an ageing problem and investigation into fishery shifts such as sex ratio and depth should be initiated. For haddock, there are apparent changes in the USA mean weight at age; however, these changes are attributed to seasonal and spatial shifts in the commercial fishery.

Production models: The TAWG used production models to obtain references points for cod and yellowtail flounder and yellowtail flounder stock status. While the agreement between the VPA and the production model is important for validation, the production model results may not be suitable for short-term projections since production models use long-term averages, and thus short-term projections may be unreliable. Where possible, the reference points from production models should be contrasted to reference points obtained by using yield per recruit with a stock recruit relationship.

Characterizing uncertainty and risk for age-structured models: The standard method for characterizing uncertainty which assumes a normal distribution for the fisheries management quantities of interest does not adequately reflect the skew which is associated with these quantities. Bootstrap techniques permit the derivation of empirical distributions based on the observed data. The median of the bootstrap distribution often does not coincide with the estimate using the original sample data. The bias corrected percentile method adjusts for this type of bias and provides better confidence statements than the percentile method. Approximating the bias correction by >shifting= the percentile distribution to account for the bias will center the median but may not adequately reflect the shape of the distribution. The uncertainty in the assessment will be carried forward to one year projections for advice to Canadian managers and to three year projections for advice to USA managers. The TAWG agreed to develop m! ethods to incorporate bias into uncertainty estimates, projections and risk assessments. Methods of bias correction will remain slightly different among Canadian and US assessments.

Use of a plus group in Yield per Recruit analyses: It is important to use the appropriate weighted mean weight for the plus group, and that a plus group should be used. Sensitivity runs are presented in the Georges Bank cod assessment and the Georges Bank yellowtail flounder assessment. Increasing the number of individual age groups to an age where there is little change in the average weight for subsequent ages, reduces the sensitivity of results to the average weight used in the plus group.

Transboundary Assessment Working Group Agenda
March 31 - April 3, 1998

There are specific issues identified for each species in the timetable but for each stock we reviewed the following generic material:

Fishery landings
- Longest available historical overview amounts, seasons, fleets, any recreational, etc.
- Recent developments and 1997 details
- Length and age composition details and aggregate for 1997, historical perspective
- Discards and mis-reporting

Abundance trends
- Commercial catch rates, comparability over years, impact of fishery management changes and changes in fishery distribution
- Surveys, distribution patterns, trends, Z, year-class strength (multiplicative model)

Current stock status
- Production model
- Age structured models, treatment of plus groups, characterizing uncertainty and risk
- Other models

Reference points
- Y/R, SPR, treatment of plus groups
- MSY, production models and/or Y/R + SR approaches

Projections
- 1 year, recovery periods, treatment of uncertainty and bias

NOTE: Some topics could be discussed profitably for all stocks simultaneously. The timetable is given as a guide only and we should be flexible enough to accommodate such discussions.

Tuesday 8:30 - 10:00 Documentation
- Technical background papers
- Advisory and status reports
- Others required documents?
- Timing, production, distribution, etc.
- General Issues

10:15 - 12:00 Yellowtail
- Specific issues: Production model 1 year forecasts, are they reliable?

12:00 - 1:00 Lunch

	1:00 - 5:00	Yellowtail cont'd
Wednesday	8:30 - 12:00	Cod - Specific issues: - Historical perspective on landings and abundance trends - Comparison of 5Z and 5Zjm
	12:00 - 1:00	Lunch
	1:00 - 5:00	Cod cont'd
Thursday	8:30 - 12:00	Haddock - Specific issues - Impact of using only most recent years in calibration - Comparison of 5Z and 5Zjm
	12:00 - 1:00	Lunch
	1:00 - 5:00	Haddock cont'd
Friday	am	Further discussions if needed

Terms of Reference

1A. **Georges Bank cod**

a. Update the status of Georges Bank cod through 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
b. Provide projected estimates of catch for 1998-1999 and spawning stock biomass for 1999-2000 at various levels of F.
c. Review existing biological reference points and advise on new reference points for Georges Bank cod to meet SFA requirements.

1B. **Eastern Georges Bank cod**

a. Update the status of Eastern Georges Bank cod through 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
b. Provide projected estimates of F for 1998 and beginning of year adult biomass for 1999 at various levels of yield in 1998. Characterize the risk of exceeding F0.1 and the risk of not achieving 0% , 10% and 20% adult biomass increase for the various levels of yield in 1998.
c. Provide a historical perspective for current stock status and production.
d. Compare assessment results to those for all of Georges Bank.

2A. **Georges Bank haddock**

a. Update the status of Georges Bank haddock through 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
b. Provide projected estimates of catch for 1998-1999 and spawning stock biomass for 1999-2000 at various levels of F.
c. Review existing biological reference points and advise on new reference points for Georges Bank haddock to meet SFA requirements.

2B. **Eastern Georges Bank haddock**

a. Update the status of Eastern Georges Bank haddock through 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
b. Provide projected estimates of F for 1998 and beginning of year adult biomass for 1999 at various levels of yield in 1998. Characterize the risk of exceeding F0.1 and the risk of not achieving 0% , 10% and 20% adult biomass increase for the various levels of yield in 1998.
c. Provide a historical perspective for current stock status and production.
d. Compare assessment results to those for all of Georges Bank.

3A. **Georges Bank yellowtail flounder**

a. Update the status of Georges Bank yellowtail flounder through 1997 and characterize the variability of estimates of stock size and fishing mortality rates.

b. Provide projected estimates of catch for 1998-1999 and spawning stock biomass for 1999-2000 at various levels of F.
c. Review existing biological reference points and advise on new reference points for Georges Bank yellowtail flounder to meet SFA requirements.
d. Provide projected estimates of F for 1998 and beginning of year adult biomass for 1999 at various levels of yield in 1998. Characterize the risk of exceeding F0.1 and the risk of not achieving 0% , 10% and 20% adult biomass increase for the various levels of yield in 1998.
e. Provide a historical perspective for current stock status and production.

Appendix IV. Meeting Remit

Georges Bank cod (5Z+6)

- Update the status of Georges Bank cod through to 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
- Provide projected estimates of catch for 1998-1999 and spawning stock biomass for 1999-2000 at various levels of fishing mortality.
- Review existing biological reference points and advise on new reference points for Georges Bank cod (5Z+6) to meet US SFA requirements.

Eastern Georges Bank cod (5Zjm)

- Update the status of Eastern Georges Bank cod through to 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
- Provide projected estimates of fishing mortality for 1998 and beginning of year adult biomass for 1999 at various levels of yield in 1998. Characterize the risk of exceeding F0.1 and the risk of not achieving 0% , 10% and 20% adult biomass increase for the various levels of yield in 1998.
- Provide a historical perspective for current stock status and production.
- Review yield per recruit reference points and if possible calculate new reference points for Eastern Georges Bank cod (5Zjm).
- Compare assessment results to those for all of Georges Bank.

Georges Bank haddock (5Z+6)

- Update the status of Georges Bank haddock through to 1997 and characterize the variability of estimates of stock size and fishing mortality rates.
- Provide projected estimates of catch for 1998-1999 and spawning stock biomass for 1999-2000 at various levels of fishing mortality.
- Review existing biological reference points and advise on new reference points for Georges Bank haddock to meet US SFA requirements.

Eastern Georges Bank haddock (5Zjm)

- Update the status of Eastern Georges Bank haddock through to 1997 and characterize the variability of estimates of stock size and fishing mortality rates.

- Provide projected estimates of fishing mortality for 1998 and beginning of year adult biomass for 1999 at various levels of yield in 1998. Characterize the risk of exceeding F0.1 and the risk of not achieving 0% , 10% and 20% adult biomass increase for the various levels of yield in 1998.

- Provide a historical perspective for current stock status and production.

- Review yield per recruit reference points and if possible calculate new reference points for Georges Bank haddock (5Zjm).

- Compare assessment results to those for all of Georges Bank.

Georges Bank yellowtail flounder (5Z)

- Update the status of Georges Bank yellowtail flounder through to 1997 and characterize the variability of estimates of stock size and fishing mortality rates.

- Provide projected estimates of catch for 1998-1999 and spawning stock biomass for 1999-2000 at various levels of fishing mortality.

- Review existing biological reference points and advise on new reference points for Georges Bank yellowtail flounder to meet US SFA requirements.

- Provide projected estimates of fishing mortality for 1998 and beginning of year adult biomass for 1999 at various levels of yield in 1998. Characterize the risk of exceeding F0.1 and the risk of not achieving 0% , 10% and 20% adult biomass increase for the various levels of yield in 1998.

- Provide a historical perspective for current stock status and production

Appendix V. Meeting Schedule

	20 April Monday	21 April Tuesday	22 April Wednesday	23 April Thursday	24 April Friday
0830-0900	Introduction	Yellowtail 5Z	Cod 5Zjm	Reanalyses	
0900-0930	TAWG Report	Yellowtail 5Z	Cod 5Zjm	Reanalyses	Report
0930-1000	Haddock 5Z+6	Yellowtail 5Z	Cod 5Zjm	Reanalyses	Review
1000-1030	Haddock 5Z+6	Yellowtail 5Z	Cod 5Zjm	Reanalyses	
1030-1100	Haddock 5Z+6	Yellowtail 5Z	Cod 5Zjm	Reanalyses	
1100-1130	Haddock 5Z+6	Yellowtail 5Z	Cod 5Zjm	Reanalyses	General
1130-1200	Haddock 5Z+6	Yellowtail 5Z	Cod 5Zjm	Reanalyses	Observations
1200-1230			Cod 5Zjm	Reanalyses	
1230-1330	Lunch	Lunch	Lunch	Lunch	
1330-1400	Haddock 5Zjm	Cod 5Z+6	Reanalyses		
1400-1430	Haddock 5Zjm	Cod 5Z+6	Reanalyses		
1430-1500	Haddock 5Zjm	Cod 5Z+6	Reanalyses	Report	
1500-1530	Haddock 5Zjm	Cod 5Z+6	Reanalyses	Review	
1530-1600	Haddock 5Zjm	Cod 5Z+6	Reanalyses		
1600-1630	Haddock 5Z+6	Cod 5Z+6	Reanalyses		
1630-1700	Haddock 5Z+6	Cod 5Z+6	Reanalyses		
1700-1730	Haddock 5Z+6	Cod 5Z+6	Reanalyses		
1730-1800	Haddock 5Z+6	Cod 5Z+6	Reanalyses		
1800-1830	Haddock 5Z+6		Reanalyses		
1830-1900	Haddock 5Z+6		Reanalyses		
1900-1930	Haddock 5Z+6		Reanalyses		

Appendix VI. List of Working Papers

O'Brien, L. 1998 Assessment of the Georges Bank cod stock for 1997. WP 98/65

Cook, R. 1998. Some observations on the assessments of Georges Bank cod and yellowtail flounder. WP 98/66

Cook, R. 1998. An analysis of Georges Bank haddock using ICES assessment tools. WP 98/67

Brown, R. 1998. U.S. assessment of the Georges Bank (5Z) haddock stock, 1998. WP 98/68

Hunt, J.J. and Buzeta, M.-I. 1998. Population status of Georges Bank cod in unit areas 5Zj,m for 1978-98. WP 98/69

Gavaris, S. and Van Eeckhaute, L. 1998. Assessment of haddock on eastern Georges Bank. WP 98/70

Neilson, J.D. and Cadrin, S.X. 1998. 1998 assessment of Georges Bank (5Zjmnh) yellowtail flounder. WP 98/71

Appendix VII. List of Recommendations

Report of the Transboundary Assessment Working Group

- The TAWG recommended a USA/Canada Ageing Workshop, with time, place, and agenda to be arranged by the respective scientists in charge of age reading in Woods Hole and St. Andrews.

Considerations on Alternative Model Formulations

The TRAC discussed some alternative approaches that will be worth exploring for future assessments:

- The use of different assumptions about the error of the survey indices, such as multinomial or weighted log-normal distributions. Limited sensitivity analyses conducted on the haddock assessment showed that abundance estimates dropped substantially when the lognormal distribution assumed in the base assessment was replaced by a multinomial distribution. The TRAC could not decide which of the two approaches would be more appropriate based on the information at hand, which illustrates that the actual uncertainty about stock status can be substantially larger than indicated by the assessments.

- Estimation of trends in relative abundance and total mortality from survey data alone. While absolute abundance cannot be estimated without catch information, the TRAC found it useful to contrast trends in abundance and fishing mortality indicated by the surveys with those estimated using VPA. For example, a separable model fitted to survey indices of age-specific abundance for cod indicated similar trends in mortality and year- class-strength as the assessment. Other methods explored based on linear models could not corroborate the strong reduction in fishing mortality estimated by the assessments.

- Allowing for errors in the catch at age observations. The assumption that catch at age is known can result in unrealistically high variability in the age specific exploitation pattern. It would be of interest to evaluate the effect of relaxing this assumption on both the point estimates and their estimated uncertainty.

- Extending the range of years used in the assessment to make use of the complete series of survey observations dating back to 1963. While this may not be necessary for estimating current stock status, the evaluation of management options and reference points cannot be accomplished by only looking at a restricted period during which biomasses have been very low compared to historical averages. Longer-term trends in productivity need to be considered for stock-recruitment analysis, as exemplified by haddock and cod. The extension of the analysis to cover periods for which the age composition of the catch is unknown may not be straightforward using backward catch-at-age analysis. The integration of various pieces of information in a unified assessment could be more easily accomplished

using forward catch-at-age methods, which do not depend on knowledge of catch-at-age to reconstruct population abundance.

Observations on Bias Correction of Parameter Estimates and Related Issues

The TRAC agreed to the following:

- We wish to characterize the uncertainty of fisheries management quantities (projections or current year values).
- It is preferable to derive empirical bootstrap distributions rather than assuming a normal distribution.
- Empirical bootstrap distributions can be derived either by the "percentile" or the "bias corrected percentile" methods. In the statistical literature, the "bias corrected percentile" method is considered preferable, but the differences will depend on the degree of bias.
- Point estimates of the management quantities, when adjusted for mean bias, will correspond closely, but not exactly, to the 50^{th} bias corrected percentile.
- There may be a noticeable discrepancy between the point estimates, which are not adjusted for bias and the 50^{th} percentile when bias is large.
- The effects of model misspecification on estimates of bias and bias corrected percentiles have not been explored.

The Need for Dialogue on Assessment Methodology

- It was recommended to hold an assessment methods workshop on the east coast in January 1999. The issues to address would include an examination of alternative models as well the communication and interpretation of risk.

Observations on the TRAC Process

- It was recommended that Canada and the USA undertake analyses on the distribution of Georges Bank cod and haddock, and investigate alternative assessment unit definitions.

5Z+6 Cod

- It was recommended that further analyses of the spatial distribution of the fishery by gear type be conducted to evaluate the influence of gear on the age composition.
- It was recommended that a description of the sensitivity analyses performed to evaluate the influence of the recreational data on the VPA be presented in the assessment document.

- It was recommended that an examination of the spatial distribution of the resource be undertaken to understand historical fishing fleet behaviour.

- It was recommended that analyses be undertaken which allow examination of Z trends in the surveys for comparison with the VPA estimates of mortality.

- It was recommended that assessment models be explored that allow quantitative use of the historical fishery and survey information.

- It was recommended that the potential for re-stratification of the USA survey, to account for the effect of the permanent Georges Bank closed areas on the abundance indices derived from the surveys, be examined.

5Zjm Cod

- It was recommended that exploitable biomass by gear type be determined to attempt to reconcile assessment results with industry perceptions of improved abundance in certain size classes (for longline gear).

- It was recommended that the implications of different partial recruitment patterns in the projections be examined.

5Z+6 Haddock

- It was recommended to use commercial mean weights at age for stock weights this year, and use survey mean weights at age for stock weights when the assessment is updated.

- It was recommended to investigate other ratio estimators for estimating discards.

- It was recommended that there be improved length and age sampling of the US fishery, particularly the spatial-temporal component. An increase in sea sampling will be needed to characterize the discard portion of the catch, especially if an increase in regulatory discards occurs. Alternative sampling designs for gathering biological information should be investigated.

- It was recommended to examine the effects of treating zero survey data as missing values and develop methods to include "zero" data points.

- It was recommended that to explore the use of multinomial error structure in the catch at age matrices.

- It was recommended that to examine the impact of fixing the F on terminal ages.

- It was recommended that the issue of bias correction and methods to bias correct be explored.

- It was recommended that spawning stock biomass estimates in future assessments should be estimated using fishery-independent estimates of mean weights at age.

5Zjm Haddock

- It was recommended that alternative models be considered in a venue more appropriate than this meeting as there are others who should provide their expertise.

5Zhjmn Yellowtail

- It was recommended that Canadian aging program for yellowtail be developed. Also, research is required on the use of otoliths as an aging structure.

- It was recommended that the implications of doing sex-aggregated vs. sex-separated SPAs be investigated with simulation. Consideration should be given to the precision of stock size estimates, possible confounding of population wide and sex-specific partial recruitment and weights at age, and the costs associated with doing essentially two SPAs.